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Analysis

Conflicts in Transdisciplinary Research: Reviewing Literature and Analysing a Case of Climate Adaptation in Northwestern Germany

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ABSTRACT

Transdisciplinary research has been introduced as an approach to integrate different bodies of knowledge to learn and to develop solutions towards socio-ecological transformations. In these concepts, broad stakeholder involvement is intended to promote knowledge integration, consensus formation and activation of local actors to initiate and advance learning and change processes. In doing so, however, transdisciplinary processes enter societal battlegrounds and meet conflicting interest and knowledge claims. Thus, building on the discussion on transdisciplinarity in the context of sustainability-related research, the paper seeks to understand when and why which types of conflicts emerge in sustainability-related transdisciplinary research, how they affect knowledge integration, and how they can be resolved. It develops a categorization of conflicts including differing values, conflicting interests, dissimilar claims of legitimacy, and diverse knowledge claims. They are applied empirically in the analysis of a project on regional adaptation to climate change in Northwestern Germany. It studies processes and outcomes with regard to the societal impact of the project and discusses experiences of conflicts and relevant solutions. The paper finds that societally relevant transdisciplinary research processes need to be prepared for conflict resolution and overcoming resistance and blockages in cases when consensus formation and mutual agreement is not attainable.

1. Introduction

Transdisciplinary research is gaining support and is growing particularly in the field of sustainable development and environmental problem solving (Brandt et al., 2013). It can broadly been defined as "a reflexive, integrative, method-driven scientific principle aiming at the solution or transition of societal problems by differentiating and integrating knowledge from various scientific and societal bodies of knowledge" (Lang et al., 2012, p. 6f.).

Based on traditions in the philosophy of science calling for a revocation of the purely instrumental function of science in society and of the growing specialisation in sub-disciplines, the discourse on transdisciplinary research builds on several epistemological strands (Hirsch Hadorn et al., 2008b). In its present form it has largely been shaped by the call for Mode-2 science integrating science and society (Gibbons et al., 1995; Gibbons, 2000), the notion of post-normal science (Funtowicz and Ravetz, 1993; Gallopin et al., 2001), and the rising awareness of the repercussions of scientific-technical work on society (Beck, 1986). Transdisciplinarity has also been nurtured by the unavoidable societal relevance and role of scientific work and scientists themselves as articulated in the science and technology studies (STS) (Jasanoff, 2003, 2004). From these traditions, the focus on crossing disciplinary boundaries as well as the stronger focus on societally relevant problems and their solutions emerged. Transdisciplinarity is characterised by the focus on complex and often contested societal problems. In the realm of sustainable development these problems can hardly be described, understood or solved through one disciplinary lens alone and require a combination of physical-environmental and social dimensions (Pohl, 2011; Bernstein, 2015). As such, transdisciplinarity developed into a central pillar of the discussion on sustainability science that calls for novel forms of integrative problem-oriented research and science-policy interaction through stakeholder participation and the integration of their diverse forms of knowledge and expertise (Kates et al., 2001; Spangenberg, 2011).

The resulting challenges for scientists and society include the integration of societal stakeholders such as the private sector, the broader public and their respective bodies of knowledge as well as diverse scientific disciplines into the process of generating knowledge (Clark et al., 2005). This form of knowledge integration has been described as central to transdisciplinary research including systems knowledge, target knowledge and transformative knowledge (Hirsch Hadorn et al., 2008b). The rapidly growing body of work in transdisciplinary research (Brandt et al., 2013) developed the notion of collaborative work between researchers and non-academic experts or lay-people further. It

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calls for a problem-focused co-operation of scientists with non-academic actor groups in different stages of the research process including problem identification and definition, common research and problem-solving processes as well as interactive dissemination and implementation of results (Jahn et al., 2012; Lang et al., 2012; Scholz et al., 2006). The transdisciplinary knowledge-production process is called upon to open up to civil society groups, holders of local lay knowledge, corporations and other stakeholders and involve them in mutual learning processes (Hirsch Hadorn et al., 2008a, 2008b; Pohl, 2011; Wiek, 2007). While this integration has even been strengthened by the notion of "Mode 2 transdisciplinarity" (Scholz and Steiner, 2015a), there is growing recognition of the additional challenges it entails.

The other key element of transdisciplinary research is the focus on developing solutions to societal problems (Lang et al., 2012; Polk, 2015). Through stakeholder involvement, transdisciplinary processes are expected to become more practical and closer to every-day lives of people. Stakeholder and knowledge integration is intended to serve the objective of developing balanced, broadly acceptable and implementable solutions to sustainability problems. Scientists are therefore expected to be more involved with the world outside academia. Vice versa, public and private spheres are thereby increasingly affected or intentionally affected by academic actors and research. In doing so, political and academic domains intermingle and scientists take up societally relevant or even political roles (Jasanoff, 2004) with entirely new forms and dimensions of contestation and conflict. Since many issues in transdisciplinary sustainability-related research are contested and in this sense political by nature, research processes enter into conflicts. In contrast to often violent political conflicts (Jeong, 2008), in transdisciplinary processes conflicts can be understood as competition, opposition or (non-violent) struggles among actors based on differences in values, interests, and knowledge claims. However, even though most of the literature on transdisciplinary research calls for the involvement of stakeholders into research practice, there seems to be little recognition of the potential conflicts and pitfalls these approaches entail for achieving the goals of transdisciplinary research (van den Hove, 2006; Voss and Bornemann, 2011).

This is even more surprising since the debate on environmental conflicts and justice figures prominently in ecological economics (Martinez-Alier, 2003) and in environmental social sciences at large (e.g. Diehl and Gleditsch, 2001; Redpath et al., 2013). These strands of literature start out from the assumption of latent or open conflicts in many environmental issue areas and develop notions how to address or resolve them. However, thus far little interaction between these discussions and the transdisciplinarity discourse could be observed.

This paper, therefore, seeks to systematically understand when and why which types of conflicts emerge in sustainability-related transdisciplinary research, how they affect knowledge integration and societal problem solving, and how they can be resolved. Starting out from a systematic review of the transdisciplinarity literature in Section 2 asking whether and how conflicts have been addressed in the empirical and conceptual literature on sustainability, the paper identifies different types of conflicts that can emerge in participatory transdisciplinary processes. These categories will then be employed to analyse conflicts in a case study of a transdisciplinary project on regional climate adaptation (Section 3). Here, I study which types of conflicts emerged and why as well as which solutions have been found to deal with them. Section 4 discusses the findings of the case study in relation to the larger transdisciplinarity literature and Section 5 draws some conclusions.

2. Conflicts in Transdisciplinary Research - A Literature Review

2.1. Methodology

Documented through a growing body of literature there is an increasing understanding in the scholarly community on the relevant mechanisms and pitfalls of stakeholder participation in general and in transdisciplinary research concerning sustainability challenges in particular. This section, therefore, embarks on a review of the literature on transdisciplinary research in sustainability science. It attempts to identify whether conflicts are an issue in the literature and which types and origins of conflicts have been identified in conceptual and empirical work and what solutions to the conflicts have been found. Through this review, this paper seeks to identify distinct types and related causes of conflicts in sustainability-oriented transdisciplinary research processes that either hinder knowledge integration and mutual learning of different parties or block the transfer from knowledge to action and practical solutions.

To gain an overview how salient the issue of conflicts is in the relevant literature, the review started out with a web search in bibliographic databases, namely *Scopus* and *Web of Science* considering the period 1960 until May 2018. In Web of Science, the search category "Topic" was used whereas in *Scopus*, the search category was "Keywords". The search used the keywords "transdisciplinary research", "transdisciplinary" as well as "transdisciplinarity" as first-tier search items. In a second step, the keywords "conflicts" and "sustainability" were combined with the first-tier keywords in both databases. Zooming into the key topic of this paper, a further search applied the keywords "conflicts and sustainability" together with the main keywords as combined search items. Other related terms like "obstacles" or "challenges" had been left out because of the specific focus on conflicts among actors that constitute a stronger form of social contestation than almost omnipresent "challenges". In Scopus, the search processes focussed on keywords of articles whereas in Web of Science, the search processes focussed on topics. In addition to the database search and the selection of the thematically relevant papers, the review included author-selected papers that are central to the transdisciplinary debate, but did to not appear in the keyword-search.

Based on the numeric overview of the search terms, a qualitative analysis combining systematic and traditional review methodologies (Haddaway et al., 2015; Petticrew and Roberts, 2006) has been conducted. It looked into the abstracts and full texts of all the papers that were found to be of topical relevance searching for the mentioning or analysis of conflicts and different types of conflicts in sustainability-related transdisciplinary research processes. These contributions to the debate were analysed based on a qualitative analysis with the goal to identify relevant types of conflicts in transdisciplinary research and their specific causes.

2.2. Numerical Results

The initial web search produced a total amount of 52 articles from both bibliographic databases, Scopus and Web of Science. After deducing identical papers that appeared in both databases, in total 35 papers remained (see Annex 1). The analysis of the abstracts of these papers identified 12 papers that systematically addressed conflicts in sustainability-related transdisciplinary research and/or discussed solutions to the conflicts. The author-based selection based on a snowball-search added another 18 thematically relevant papers that address conflicts or closely related topics in transdisciplinary research.

As indicated in Table 1, the bibliometric search in central publication databases showed that the vast sustainability-related transdisciplinarity literature thus far only reluctantly addresses conflicts. This reluctance is particularly striking given the significance of conflicts as described in the few sources available in this respective literature. Also considering the broad literature on environmental conflicts (e.g. Adams et al., 2003; Martinez-Alier, 2003; Paavola, 2007), the transdisciplinarity literature appears to be overly optimistic about the ability of its approach to avoid or overcome conflicts. In other words, there is an apparent gap in this literature with regard to embracing and thoroughly studying conflicts in transdisciplinary processes.

Table 1
Bibliographic search, accessed 17 May 2018.

Data base	Search items (First tier)	Search category	Number of hits	Combined search: 1st tier item AND "sustainability"	Combined search: 1st tier item AND "conflicts"	Combined search: 1st tier item AND "conflicts AND sustainability"
Scopus	"Transdisciplinary" and "research"	Keywords	476	52	7	0
Scopus	"Transdisciplinary"	Keywords	1029	108	11	0
Scopus	"Transdisciplinarity"	Keywords	808	147	5	2
Web of Science	"Transdisciplinary" and "research"	Topic	2076	396	74	14
Web of Science	"Transdisciplinary"	Topic	3553	550	124	25
Web of Science	"Transdisciplinarity"	Topic	937	261	33	11
Total			8879	1514	254	52

2.3. Conflicts in the Transdisciplinarity Literature

From the core set of papers, only a few and rather recent *empirical* papers report on conflicts in transdisciplinary projects and how they could be resolved. Bracken et al. (2014: 8) describe "where differences emerged between what it was that the stakeholders had hoped to gain and what was actually possible through particular research projects, conflict was common". Based on a survey with academics involved in transdisciplinary research, Mielke et al. (2017) report about conflicts between scientific and disciplinary knowledge on the one hand and between scientific and stakeholder knowledge on the other. In a similar vein, Thompson et al. (2017) found underlying conflicts between the expectations of actors regarding traditional research structures versus transdisciplinary research approaches. Also Rose et al. (2017) report about role conflicts in their case study on the city of Wuppertal, Germany. In their 10-years long transdisciplinary project, they confirmed that anticipated conflicts and reflection of expectations from early on helped the transdisciplinary work to avoid aggravating conflicts. Conflicting mental models and epistemologies were described by Vanasupa et al. (2014) as crucial drivers for transformative learning within an industry-related transdisciplinary project. These conflicts required intensive dialogue and transformations of long-held convictions by most participants. Wuelser and Pohl (2016) found "conflicting policies" in place in different research projects. Ernst et al. (2017: 31) identified differences in the "underlying values, norms, perspectives and interests of the participating stakeholders" as sources of conflicts that can be overcome by visioning processes. In their study of tidal river management in Bangladesh, Gain et al. (2017) found a situation of severe land-use conflicts between the interests of different stakeholders that required extensive conflict mitigation involving local organisations and individuals. Similarly, Denney et al. (2018) describe "cattle-raiding conflicts" between stakeholders in the Horn of Africa that substantially impair transdisciplinary processes. A case study on climate change and land use in Southern Amazonia by Schönenberg et al. (2017) also describes "severe conflicts on land use and forest protection". Schmidt and Pröpper (2017: 365) "identified TD [transdisciplinarity] as falling victim to a kind of tragedy of the commons, paralysed between existing power structures and conflicting interests" within academic institutions as well as in the collaboration with non-governmental organisations. In their North-South project, pre-existing conflicts grew stronger between participating parties and could not be resolved.

Those *conceptual* papers mentioning conflicts give a number of reasons why in many transdisciplinary processes conflicts of different kinds are likely to occur. Scientists within transdisciplinary research processes are essentially described as being involved with political and normative questions. They thus need to address them actively by establishing forms of practically relevant and inclusive forms of research and development that build on mutual learning (Hirsch Hadorn et al., 2008a; Hoffmann et al., 2017; Scholz and Steiner, 2015a). However, the question whom to involve remains difficult since the composition often determines the level of contestation and conflicts during the process as well as in the outcomes. By integrating stakeholders representing different groups in society, societal conflicts are inevitably taken on board and imported into transdisciplinary processes. Among the challenges identified in the conceptual transdisciplinarity literature, conflicting values and ethical argumentation lines figure prominently (Hirsch Hadorn et al., 2006; Seidl et al., 2013). In his analysis of challenges in transdisciplinary research, Wiek (2007: 56) describes the "reluctance to face exposure" by stakeholders in particular in contested issue areas such as nuclear-waste disposal. He also flags the frequent observation of value conflicts and diverging preferences of involved experts and lay citizens. These require negotiation and mediation processes rather than mere information sharing (see also Scholz and Steiner, 2015b). In a global perspective, conflicts between different cultures and religions will pose an additional challenge, as Scholz et al. (2018) emphasise.

In a similar vein and acknowledging the political nature and conflicting interests, Lang et al. (2012) recommend a thorough stakeholder mapping to address the most appropriate set of actors to be involved. However, a strong emphasis on adequate representation of all legitimate actor groups, almost automatically includes all conflicting values, interests and knowledge claims into the process. Leventon et al. (2016) illustrate this challenge and provide a multi-step approach to identify relevant stakeholders, their needs and interests as well as their motivation in several cases of transdisciplinary soil research.

Closely connected is the challenge of different framings in transdisciplinary research (Wuelser and Pohl, 2016). Different actors including scientists bring along diverging frames of the problem at hand and the potential strategies to solve it. In scientific contexts, these are regularly dominated by disciplinary perspectives and their claims regarding solid and credible knowledge. In more general terms, Pohl (2011) relates these differences to distinctive "thought-styles" according to Fleck (1935/1993). They are hosted by thought collectives, i.e. actor groups or communities, that interact within participatory transdisciplinary processes and bring their views and thought-styles in exchange and ideally advance them into a "comprehensive, multi-perspective, common-good oriented and useful new approach to a problem" (Pohl, 2011, p. 623). Pohl et al. (2010) claim that thought-styles demonstrate power differences in particular between researchers and lay-persons involved. Based on their analysis of four transdisciplinary projects, these power differences or potential conflicts can be resolved if researchers adopt the role of a "reflective scientist" and do not act as "facilitators" or "intermediaries" which served better the purposes of integrating different thought-styles.

In essence, there is recognition of different types of conflicts in the sustainability-related transdisciplinarity literature. However, as yet, it is only a small minority of the transdisciplinary studies that address conflicts. In sum, there is little systematic conceptual or empirical work and in-depth discussion on when, where, and why conflicts occur and

how they have been resolved practically.

2.4. Types of Conflicts in Participatory Approaches and Transdisciplinary Research

Building on these discussions in the related literature, this section synthesizes four main sources of conflicts in sustainability-related transdisciplinary research processes that either hinder knowledge integration and mutual learning of different parties or block the transfer from knowledge to action and practical solutions. They originate in the existing literature and have been formed into four categories on the basis of logical reasoning in the attempt to identify distinct categories with specific qualities that also bear relevance for the following empirical study. These relate to (a) differing values, (b) conflicting (economic) interests, (c) dissimilar claims of legitimacy, and (c) diverse knowledge claims.

2.4.1. Differing Values

Much political contestation and dispute has its origin in differing values about human life and co-existence including cooperation and rules in public spheres (*res publica*). Values determine what individuals or groups consider as "good" or "bad" and give orientation and direction for human action and relate to emotions as well as ethical argumentations or moral convictions (Scholz et al., 2018). In parts of the transdisciplinarity literature, value-related conflicts are seen as inevitable elements of stakeholder participation (Jahn et al., 2012; Lang et al., 2012; Scholz and Steiner, 2015b; Wiek, 2007). In particular, since the complex challenges of sustainability lack determinacy and are characterised by a high degree of uncertainty, different value systems are related to different standpoints about problem framing, understanding root causes and prioritizing solutions: "Hence participation emerges as a consequence of the acknowledgement of an irreducible plurality of standpoints that stems from the complex nature of the issues at hand and of the necessity of living together on the same planet" (van den Hove, 2006, p. 12). Most modern societies are characterised by a plurality of values that are also accepted and promoted as constitutional element of democratic systems, i.e. requiring democratic ways of political discourse, communication and decision making with opposing value sets often formed in political parties (Dryzek, 2000).

What renders value differences problematic in transdisciplinary research or decision making process is the possibility that they might be incommensurate. For instance, religiously based value sets or fundamentally different understandings of the roles and potentials of individuals or groups within societies or regarding the state and its functions and defects. In these cases mediation, negotiation, or processes of value alignment (e.g. Renn et al., 1993) often do not lead to consensus or the identification of commonalities and areas of agreement. What is generally more likely is a hegemony of one particular set of values in a certain issue area or process that tends to marginalize other views or value sets (Jasanoff, 2003; Jasanoff and Long-Martello, 2004; Pohl et al., 2010). These differences can also block or significantly impair the success of transdisciplinary research processes.

2.4.2. Conflicting (Economic) Interests

Second, there are economic or predominantly self-interested motivations and preferences of individuals or specific stakeholder groups that often impact deliberative processes, mutual learning, and consensus formation in transdisciplinary research. This might affect the goal attainment vis-à-vis sustainable development: "Plurality of norms and values within society as well as strong private interests of societal actors give reason for ongoing deliberation about concrete purposes for sustainable development, which gives a somewhat arbitrary character to the so-called target knowledge" (Hirsch Hadorn et al., 2006, p. 126). Strong private interests and strategic behaviour can also hinder the inclusion of specific options to solve a sustainability problem at hand. In particular often well-organized and highly qualified actors from companies or business associations prioritise their corporate interests before the common good or more mutually agreeable positions or options. This domination and limited willingness to compromise from these groups has hampered many deliberative processes e.g. to mediate conflicts about nuclear waste, other forms of waste disposal, planning of airports and roads (e.g. Wiek, 2007). Thus, for many transdisciplinary processes, the critical question arises whether to involve strong interest-based actor groups such as big industry corporations or to develop a solution rather with civil society actors and public agencies alone. Also conflicts between herders and farmers fall into this category (Denney et al., 2018). However, when excluding significant groups, these processes jeopardize their legitimacy in a larger societal context.

2.4.3. Dissimilar Claims of Legitimacy

Through their relation to real world problems and political processes that involve formal democratic decision making and state agency-driven implementation, transdisciplinary processes often touch upon issues of legitimacy. The transdisciplinary literature describes two general areas where challenges of legitimacy occur. First, Lang et al. (2012, p. 39) discuss the challenge to relate transdisciplinary processes to official political forms of decision making and see the need to "ensure complementarity between the transdisciplinary project and ongoing political processes". This can be achieved through the involvement of political actors and the respective public authorities. Second, there is the legitimacy of the transdisciplinary knowledge generation and mutual learning process itself. Matson et al. (2016, p. 115) find that "legitimacy is the most subtle of the dimensions of trust in knowledge." It requires a high awareness by the scientists involved to understand claims of lacking fairness, e.g. in North-South projects, and perceptions of bias that might not be understood from within scientific contexts, but from the perspective of societal stakeholders. There have also been experiences of failed knowledge integration where specific bodies of knowledge were not considered as relevant and timely to the decision needs of societal actors because they were too complex, badly communicated, or too late (Cash et al., 2003). In particular, when stakeholders perceive scientists as being biased in favor of one specific group or actor, their support for the process or its results often fades. Thus a high degree of transparency about the specific roles, scientists and stakeholder representatives have in transdisciplinary processes is advisable to promote mutual understanding and to advance knowledge integration (van den Hove, 2006; Pohl et al., 2010).

2.4.4. Diverse Knowledge Claims

A fourth category of potential sources of conflicts in transdisciplinary multi-stakeholder processes are diverging claims to truth of opposing bodies of knowledge that do not allow for knowledge integration. The literature describes epistemic differences between different academic disciplines and their potential contributions to transdisciplinary processes (e.g. Vanasupa et al., 2014). Jahn et al. (2012, p. 6) label this category as "knowledge conflicts" that occur in the problem framing phase and cannot be resolved by collecting more data. Lang et al. (2012) find one root cause of a lack of integration between different bodies of knowledge in varying methodologies and quality standards. On the other hand, much stakeholder knowledge can claim to be practice-proven. What Lang et al. (2012) suggest to address this problem is to clarify underlying epistemological understandings as well as methodological standards and approaches and to be explicit about the practical uses and the implications of the different bodies of knowledge. Also more inclusive forms of knowledge generation help such as in the Intergovernmental Panel on Climate Change where more and more critics have been included into the process (Siebenhüner, 2014). In addition, Jahn et al. (2012) propose to identify an integration concept that provides a means for the integration of the different bodies of knowledge and that should ideally benefit all participating actors, e.g. through an effective solution or a better understanding of a given problem.

3. Understanding Conflicts in a Case of Climate Adaptation in Northwestern Germany

Do these categories of conflicts and barriers to transdisciplinary mutual learning processes help to explain the experiences in the specific case study of a 5-years transdisciplinary project on regional adaptation to climate change in Northwestern Germany? This section will analyse this particular case with regard to the conflicts that occurred in the context of stakeholder participation and knowledge integration in the project. It seeks to categorize the experiences with the help of the four sources of conflict described above.

3.1. Methodology

Methodologically, the case-study analysis builds on published project results (see von Gleich and Siebenhüner, 2015; Grecksch and Winges, 2017), unpublished documents including minutes of 38 steering group and three advisory board meetings as well as six internal or personal letters. Additional data has been collected from participatory observations as well as documented personal communications with eight actors involved in the transdisciplinary research processes and participatory observations in five project workshops and four conferences. Data analysis followed a process tracing approach describing central processes and tracing their key causal factors (Collier, 2011). For the purpose of this case study documents have been analysed focusing on the conflicts and their causes in the project, in particular on actors and their roles, other influencing factors, as well as the attempts to resolve conflicts. The analytical focus on conflicts in the project was applied in hindsight after the project had been concluded.

3.2. The Project "Nordwest 2050"

Following up to previous research on potential climate impacts in the downstream region of the river Weser (Schuchardt and Schirmer, 2006), the project "Nordwest 2050 – Prospects for Climate-Adapted Innovation Processes in the Model Region Bremen-Oldenburg in North Western Germany" was established in 2009 and ran until 2014. It was part of the funding initiative "Creating Climate Change-Ready Regions (KLIMZUG)" by the German Federal Ministry for Education and Research (BMBF). Its practical goal was to launch initiatives to increase the resilience of the Metropolitan Area Bremen-Oldenburg to deal with climate change. It focussed on selected economic sectors and sought to implement measures into regional planning and development processes. The project addressed a region that is home to 2.7 million inhabitants and is characterised by rural and urban areas in close vicinity to the North Sea. Based on a thorough and sector-specific vulnerability assessment of the region (see for the energy sector Gößling-Reisemann et al., 2013), the project established a set of scenario processes (see e.g. Adger et al., 2005; Berkhout et al., 2014) and included them in sectoral and a region-wide Roadmap of Change (von Gleich and Siebenhüner, 2015).

Addressing the call for proposals by the BMBF, the scientific project partners conceptualised the focus and the entire transdisciplinary process. Apart from the preparation of a regional climate adaptation strategy, the project's objectives were practical solutions to adaptation challenges in selected economic clusters including technical as well as social innovations (Adger et al., 2009). Resulting technical innovations at different stages of development include solar cooling systems, low exergy solutions, resilient logistics systems as well as adapted cultivation and processing strategies in the food industry. Organizational and institutional innovations identified in the project address adaptive governance approaches such as a climate council, innovative mechanisms regarding land use management, and climate-resilient spatial planning (see e.g. Adger et al., 2005; Hegger et al., 2012; Termeer et al., 2011).

3.3. Results I: Stakeholder Involvement and Knowledge Integration

Stakeholder involvement played a strong role in the project to ensure the integration of various bodies of knowledge and to foster social learning (Collins and Ison, 2009). Already in the proposal phase, scientists, company representatives and representatives of the Bremen state government as well as consultancies and experts from outside academia formed a consortium.[1] Due to its highly connected and integrative role in the region, the emerging project consortium chose the "Metropolregion Bremen-Oldenburg im Nordwesten e.V." (Metropolitan Region Bremen-Oldenburg in the Northwest) as its leading institution. The Metropolregion is a registered association to connect actors across the Northwestern region of Germany, including 11 rural counties, the cities of Bremen, Oldenburg, Bremerhaven, Delmenhorst, and Wilhelmshaven as well as the two federal states, Bremen-Bremerhaven and Niedersachsen (Lower Saxony). In addition, the chambers of commerce and a number of companies active in them are represented in the governing bodies of the Metropolregion. As such, the Metropolregion provided already a strong network in particular of political and private sector actors in the administratively separated, but geographically integrated region that will also share most climate impacts across administrative borders. In addition, representatives of the Metropolregion signalled a strong interest in the scientific research as well as in implementing essential results of the project.

When the project proposal was accepted and the governance structure was implemented, it included a steering group, the project coordination, and an advisory board. While the steering group included the scientific subproject leaders with five university professors as well as the project coordination, non-academic stakeholders were invited to the advisory board including governmental officials, heads of the chambers of commerce, environmental non-governmental organisations and external experts. For the coordination a special arrangement was chosen that foresaw work packages for the Metropolregion as well as for the private agency with expertise in environmental communication and media campaigns. The close integration of the Metropolregion relied on a person who was in charge of the Metropolregion in the state-government of Bremen and who also strongly supported the project consortium.

In the economic sectors that are essential for the economic capacities of the region and that were in the special focus of the project such as energy, ports and logistics, food and agriculture as well as the field of regional governance, stakeholders were extensively involved as partners from early on. 14 were private enterprises of different sizes, 5 were business-related networking organization and one was a regional public administration. All agreed to participate in the project with specific tasks. They were contacted either because of their relevance in the specific economic activity or based on existing personal contacts, or on the basis of specific practical expertise in questions of climate adaptation. Civil society groups became involved in the oversight bodies of the project. In the implementation of the project, the practitioner partners were drawn upon for stakeholder involving workshops, surveys, and for contributing to central documents of the project. In addition, stakeholders were invited to topic-specific workshops e.g. to develop sectoral roadmaps (see Fig. 1).

3.4. Results II: Knowledge Integration

Based on the experience of previous transdisciplinary research on the side of most academic partners involved, the project consortium was highly attentive to challenges of transdisciplinary work and

[1] The consortium consisted of the following members: Metropolitan Region Bremen-Oldenburg in the Northwest e.V., Sustainability Center Bremen, University of Bremen, University of Oldenburg, University of Applied Sciences Bremen, BioConsult Schuchardt & Scholle GbR.

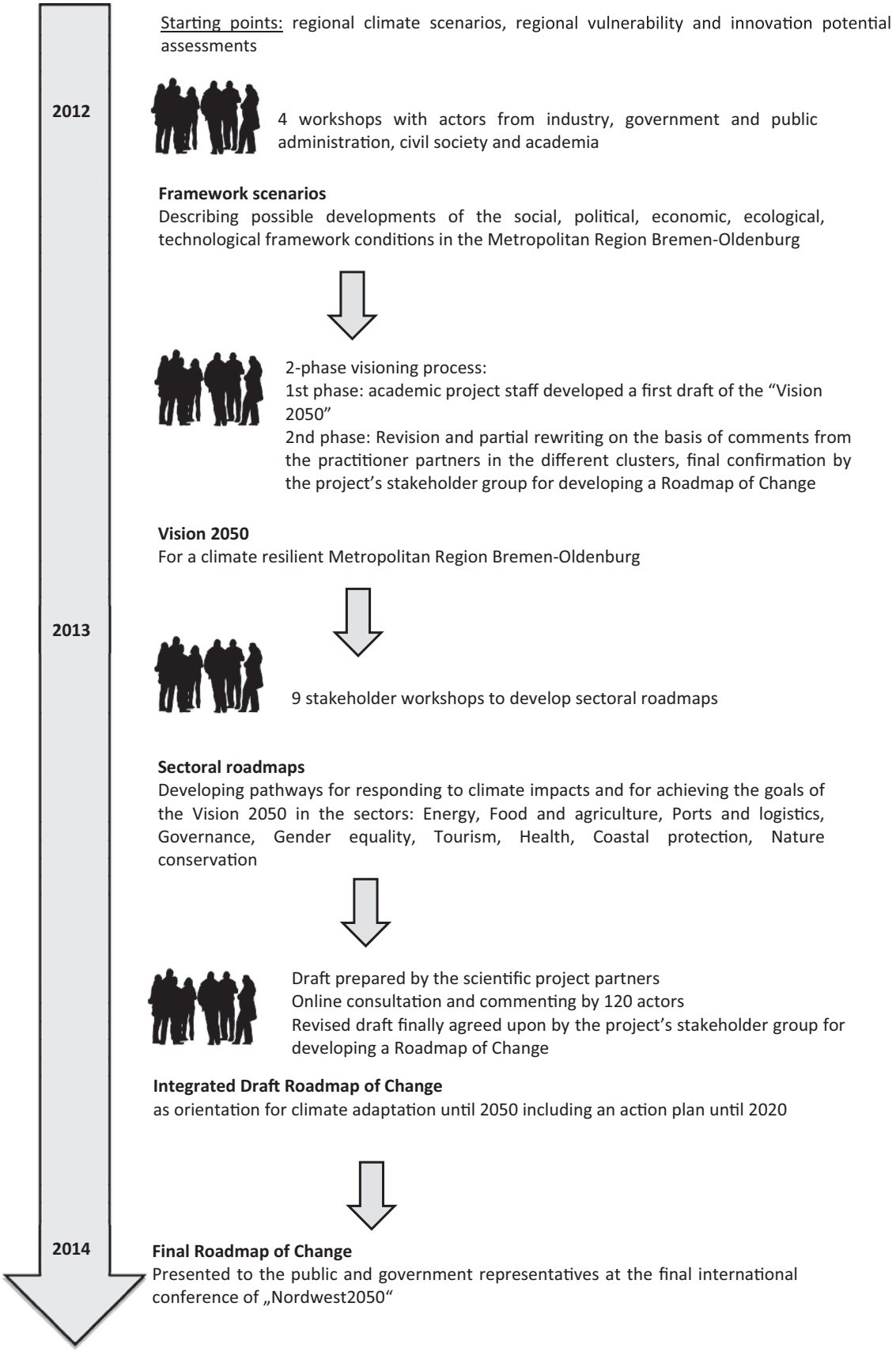
Starting points: regional climate scenarios, regional vulnerability and innovation potential assessments
2012
4 workshops with actors from industry, government and public administration, civil society and academia
Framework scenarios
Describing possible developments of the social, political, economic, ecological, technological framework conditions in the Metropolitan Region Bremen-Oldenburg
2-phase visioning process:
1st phase: academic project staff developed a first draft of the "Vision 2050"
2nd phase: Revision and partial rewriting on the basis of comments from the practitioner partners in the different clusters, final confirmation by the project's stakeholder group for developing a Roadmap of Change
Vision 2050
For a climate resilient Metropolitan Region Bremen-Oldenburg
2013
9 stakeholder workshops to develop sectoral roadmaps
Sectoral roadmaps
Developing pathways for responding to climate impacts and for achieving the goals of the Vision 2050 in the sectors: Energy, Food and agriculture, Ports and logistics, Governance, Gender equality, Tourism, Health, Coastal protection, Nature conservation
Draft prepared by the scientific project partners
Online consultation and commenting by 120 actors
Revised draft finally agreed upon by the project's stakeholder group for developing a Roadmap of Change
Integrated Draft Roadmap of Change
as orientation for climate adaptation until 2050 including an action plan until 2020
2014
Final Roadmap of Change
Presented to the public and government representatives at the final international conference of „Nordwest2050"

Fig. 1. Stakeholder participation in Nordwest 2050.
Source: adapted and translated from Born et al., 2015, p. 280.

knowledge integration from early on. In particular, the forms of interaction and engagement between scientific partners and practitioner partners from companies, networking organisations, public authorities or civil society groups were of concern to the steering group. A central challenge was communication problems based on disciplinary differentiation or highly specialised languages in academic or expert discourses. Thus, a common language was considered essential for mutual understanding, equal recognition of the different forms of expertise and knowledge integration. Therefore, two externally organized workshops were held in the first project years with the entire project consortium including all collaborators from the academic and other institutions involved. They resulted in a code of conduct suggesting commonly agreeable guidelines for the project work including mutual trust, communication rules, and conflict management, but not in a glossary or a shared language. However, no formal signature of the code of conduct by all project partners was achieved. Most participants, nevertheless, commented that the workshops sensitised them with regard to the challenges and potential solutions to problems of inter- and transdisciplinary knowledge integration.

About in the middle of the project runtime, a second problem emerged through changes in the leadership of the Metropolregion and in the related units of the state government of Bremen. The central connecting person left his post leaving a serious gap between the project consortium and the Metropolregion. In addition, a new environmental senator, i.e. state government minister, in the government of Bremen was elected and several members of the board of the Metropolregion changed. Both changes brought in personnel that had almost no connection to, nor any prior knowledge about the project and its transdisciplinary approach. In addition, the new state minister (from the Green party) was critical against climate adaptation in the first place because he favoured climate protection. Thus, early progress in knowledge integration among the different actor groups involved in the consortium was lost and the project leadership undertook little to re-establish this knowledge and build trust with the new persons involved. When the focus of the project work turned towards the more applied and stakeholder-involving generation of implementation strategies, the project was confronted with a lack of legitimacy and a disassociation of several key actors including the state minister, and the chamber of commerce.

One central integrative element of the project was a vision for the year 2050. The academic consortium members intended it to be the starting point for the backcasting exercise that should deliver concrete implementation steps (Quist and Vergragt, 2006). This “Vision 2050” for the Metropolregion Bremen-Oldenburg thus described a positive future with more resilient and climate adapted solutions practically in place. While the first draft of the vision was developed by the scientists in the project, societal stakeholders commented and contributed to follow-up versions and decided about the final product. However, not all relevant stakeholder groups brought their values to the fore and conveyed later-on little commitment to support the “Vision 2050”.

In the final phase of the project, however, the steering group was largely taken by surprise when massive attacks and criticisms were voiced concerning the Vision 2050 after it had been agreed upon and published. Industry representatives in the board of the Metropolregion criticised it publicly in the general assembly of the Metropolregion consisting of representatives of local municipalities, counties (“Landkreise”), chambers of commerce, corporations and others. Targeting at two passages in the Vision 2050, the critics voiced their disapproval of the idea of a gender-balanced and more just society as elements of a more resilient society. Also the notion of a climate council as advisory body to support climate-related policies and implementation efforts was dismissed. In a follow-up background meeting the main critic explained that this idea went contrary to the economic and social policies his agency is pursuing in the federal state of Bremen. The second contested issue concerned the institutional landscape in the region. The critics expressed concerns about different lines of legitimacy in the political realm and in the transdisciplinary research project. What was more, actors in the board of the Metropolregion viewed the suggestion of the establishment of a climate council outside the Metropolregion as a criticism of the existing institutions.

The second major step taken by the critics was a majority decision by the board of the Metropolregion distancing itself from the Roadmap of Change and the process that should lead up to it. In the released statement, the board brought forward two arguments: First, it claimed that the project ventured too far into other thematic areas beyond adaptation to climate change. The second argument criticised that the project had crossed the boundaries of a scientific undertaking and had entered the political realm. Based on the notion of transdisciplinary knowledge production that is intended to be societally relevant, the scientists in the project team regarded the reaction from the political sphere partly as success and had difficulties in separating their roles between scientific and political domains. Due to the late phase in the project and pressing timelines, the project team did not attempt to develop a conflict resolution mechanism.

Nevertheless, the project continued to integrate other stakeholders from the region including non-governmental actors, other municipalities, environmental agencies, businesses and alike. They contributed to the finalisation of the Roadmap of Change and participated in the final conference. In addition, even the Metropolregion picked up the topic of climate adaptation in its new strategy process launched at that time explicitly referring to the project Nordwest 2050 good-practice cases. Other results from the project work found their way into the climate adaptation strategy of the federal state of Lower Saxony that was finalised during the final phase of the project as well. Lastly, many project members and other stakeholders agreed upon and consequently signed a political paper stating the common commitment to fight climate change impacts and to proactively advance climate adaptation measures in the region.

3.5. Results III: Discussing Conflicts in the Transdisciplinary Process

Even though the transdisciplinary project Nordwest 2050 successfully delivered what it promised, including the regional Roadmap of Change and an international conference, it experienced serious conflicts with some societal stakeholder groups. Thus, the transdisciplinary process effectively addressed the socio-ecological problem of climate change adaptation and identified the specific vulnerability of the region and specific economic sectors and related response options. However, knowledge integration was only partially successful so that the transdisciplinary process had to be adapted to the specific situation. During the course of the process, the project team faced different types of conflicts. It was challenged to find ways to resolve them and to find solutions to the underlying societal problems. In sum, the conflicts lead to a withdrawal of several partners, but did not do harm to the knowledge integration among the other stakeholders within the “Vision 2050” and the “Roadmap of Change”. With regard to the types of conflicts identified in section 3, all four types were relevant to different degrees (see Table 2).

First, actors brought different value sets to the fore. Through the change of actors on the side of the Metropolregion, actors with more traditionally oriented value sets, e.g. regarding gender roles and a societal division of labour, gained influence also within the project consortium. They expressed their discontent with the values articulated in the “Vision 2050” coming from numerous other stakeholder groups represented in the visioning process that led up to the final document. It became clear that the project obviously drew more progressive actors groups with differing value sets focussing on a more just and risk adverse, i.e. resilient, society. The project team noticed the bias in the composition of the stakeholder groups in the preparation of the “Vision 2050”. Since the critics did not actively participate in these processes, their views were not included in the first place. Consequently, there was little opportunity to resolve the conflicts between differing values in the

Table 2
Types of conflicts in the case study.

Conflict type	Definition	Observed conflicts in the case study
Differing values	Differences between fundamental orientations in life	Significant value differences over long-term "Vision 2050"
Conflicting (economic) interests	Conflicting economic interests based on self-interested preferences of actors	Minor conflicts between economic sectors, within clusters conflicts were resolved
Dissimilar claims of legitimacy	Relationship to formal political processes and acceptability of the transdisciplinary process to actors	Severe conflicts over legitimacy of the transdisciplinary processes vis-à-vis formal political processes
Diverse knowledge claims	Diverging claims to truth of opposing bodies of knowledge	Few criticisms of the participatory knowledge generation

relevant project phase by way of value alignment as suggested by Webler et al. (1995).

Second, even though the critics were closely linked to industry and business and had strong economic interest groups behind them, the conflict lines in the project were less strongly caused by differing economic interests. The visioning process with the project team and with those stakeholders involved flagged several inherent conflicts in the region between the economic clusters such as energy and agriculture or between ports and nature conservation. Several conflict lines also surfaced within clusters such as the debate about highly intensified agricultural production, in particular industrial livestock farming, and organic agriculture or nature conservation goals. Also within the energy sector, intensive conflicts persisted between centralised and decentralised options of renewable energy provision culminating in the contestation about off-shore wind energy in the North Sea. Several of these conflicts were constituted by economic interests of affected parties such as farmers, energy providers or port operators. The conflicts within the clusters were intensively discussed in cluster-specific workshops. Here, participants found consensus or compromises mostly through postponing essential solutions or levelling out conflicting interests. Due to the central thrust of the project and of parts of the climate adaptation discourse, there was no clear conflict line, but a common concern about the future of businesses and society in the region. The project also deliberately focussed on and involved numerous companies to identify adaptation needs and potential future market opportunities through adapted products and services (Karczmarzyk and Pfriem, 2011). Thus, in particular in the first phase, it was not seen as criticising businesses per se or as being hostile against business interests in general. Therefore, it did not repeat 'old' environmental conflicts, but constituted a new constellation of conflicting interests based on differences in (climate) vulnerability.

However and thirdly, severe conflicts between legitimacy claims were observable in particular in the context of politically relevant results of the transdisciplinary processes. The formal set-up of the project consortium did not guarantee the legitimacy of the practical ambitions of the project to establish a roadmap for the region in preparation of a climate adaptation strategy. In particular, the erosion of trust in the final phase of the project between the project team members and several board members of the Metropolregion caused problems for the commonly agreed project products. These conflicts arose in two dimensions. First, acceptance of the transdisciplinary stakeholder participation processes within the project decreased in the formally legitimised political realms in particular in the state of Bremen. Thus, members of the state authorities including the state minister became less willing to accept the outcomes of a stakeholder involvement process outside the conventional political processes. The project team, however, understood itself as part of a knowledge generation process that was intended to reach out into the official governance structures as much as possible. In particular in the final project phase, the concerns from the political side grew stronger. Project members were seen as if they behaved as political actors while the scientists understood themselves as facilitators of a transdisciplinary knowledge integration process merging stakeholder perspectives as well as scientifically based episteme (Pohl et al., 2010). Second, there were conflicts about the outputs and results of the transdisciplinary process. Many political actors showed great interest in the results of the vulnerability analysis that stood in the centre of the first project phase and that largely followed traditional lines of research-practitioner interaction. However, their support faded for the critical discussions, e.g. about the constitutional structures of the city state of Bremen; and initiatives to co-develop an adaptation strategy for the state were seen critically by members of the state bodies. Nevertheless, they were willing to sign and to support a more general statement expressing their willingness to work on climate adaptation in the future. Thus, lowering the level of ambition with regard to the political commitment helped to ensure a basic acceptance and legitimacy of the project and its transdisciplinary process.

Fourth, the argument of diverging knowledge claims was hardly voiced by any of the stakeholders. The critics did not claim to build on different bodies of knowledge with specific types of methodologies but largely argued on the basis of conflicting interests and values as well as differing ways of legitimizing knowledge. Only some stakeholders criticised the participatory knowledge generation processes as not fulfilling strong scientific standards. In addition, the project team did not find full agreement over commonly acceptable ways to integrate the different (disciplinary) knowledge claims. The failure to find consensus over the code of conduct demonstrated the limits to the integration of academic and practitioner knowledge since most doctoral students in the project team expressed their interest in emphasizing scientific research and knowledge generation often in a monodisciplinary perspective. More integrative forms of work and a priority to practical solutions were seen as not conducive for their academic qualifications. Thus different knowledge claims continued to co-exist in the project.

4. Discussion

As the case of the transdisciplinary research project "Nordwest 2050" shows, stakeholder involving processes of knowledge generation and integration can be challenged by conflicts of different kinds and with specific causes. The three dozen studies identified in the literature review underline that in particular the participatory nature of the common knowledge generation processes is prone to emerging or hidden conflicts between different stakeholders. They can be caused by their value structures, their economic interests, their legitimacy claims or their understandings of credible knowledge. These conflicts can be existent from early on in transdisciplinary processes as e.g. in the case reported by Gain et al. (2017) or Schmidt and Pröpper (2017). In the case of "Nordwest 2050", the conflicts emerged rather late in the process in the final phase of the transdisciplinary process. It led to gaps in the knowledge integration since key stakeholder groups did not contribute their knowledge to the final products of the project. In line with a challenge described by Lang et al. (2012, p. 34), legitimacy of the process became a source of conflict also in the later phases of the project. Growing media and public awareness to the project gave rise to concerns by governmental and administrative actors that formal political processes might be bypassed by the project. This challenge of legitimizing processes has also been observed in other transdisciplinary projects (e.g. Pohl et al., 2010; Wiek, 2007).

As discussed in other critical analyses of participatory governance approaches (e.g., Newig and Fritsch, 2009; Scholz and Steiner, 2015b;

Stirling, 2008; Tahvilzadeh, 2015), first, the composition of the stakeholder groups involved gives rise to conflicts or can prevent them. The case study showed that the change of individuals resulted in conflicts and the withdrawal of key stakeholders. Second, even the most advanced facilitation and knowledge integration techniques (Bergmann et al., 2012) can fail to create consensus and common commitment for the results of a participatory process. This is particularly likely when fundamental value differences or other types of conflicts are not sufficiently addressed and resolved – as in the case of "Nordwest 2050". Third, impacts of the participatory processes are most likely to remain limited if conflicts persist and stakeholders feel little commitment to the outcomes and agreements. In hindsight, it could be seen that the processes and products of "Nordwest 2050" itself had limited direct societal impacts. However, the topic of climate adaptation remained high on the agenda of many actors in the region. The state of Bremen developed and adopted a climate adaptation strategy in 2018 (SUVB - Der Senator für Umwelt, Bau und Verkehr, 2018), but it ignored the project "Nordwest 2050". What seems important to stress is the finding of several types of conflicts that can occur in parallel as in "Nordwest2050". Such multiplication can lead to a blockage or an erosion of trust in the transdisciplinary knowledge integration and solution finding.

With regard to the literature on transdisciplinary research, this case study could exemplify some of the challenges described in the conceptual literature (Lang et al., 2012; Wiek, 2007). However, it also shows that the emergence of conflicts is most likely in many transdisciplinary processes that seek to impact on political processes and decision-making. Nordwest 2050 sought to become a driver of political and societal initiatives towards climate adaptation in the region. However, the conflicts in the final phase demonstrated clearly that the project had limited influence where political domains and politically contested areas were addressed. However, given the nature of the singularity of the case study presented here and the over-seeable number of similar studies of conflicts in transdisciplinary processes, a broader picture and more empirical studies of the types of conflict in transdisciplinary processes would be desirable.

5. Conclusions

Even though the literature on transdisciplinary research is hesitant to consider conflicts, knowledge integration and stakeholder participation are prone to their emergence. It seems therefore essential to prepare for conflicts in participatory and transdisciplinary knowledge generation processes and to create an awareness of potential types of conflict in these processes. Rather than avoiding or ignoring conflicts, transdisciplinary processes need to address and effectively deal with them. Related solutions should build on an understanding of the nature of the conflict and its causes and seek to address them specifically. Here, the transdisciplinarity literature can benefit substantially from the environmental conflict and justice literature where adequate procedures have been developed.

Conflicts over fundamental values will require an early-on phase to identify these fundamental values and to find agreement about commonly agreeable ones. Following deliberations should then refer to these consensual values and seek to bring the results in line with them so that all participants can agree (Renn et al., 1993, 1995). Alrøe and Noe (2014) propose a "multiperspectival" approach that requires the actors to look at the same issue also from their opponents' perspective. Even in situation of partly conflicting values, Margerum (2011) promotes "collaboration" that does not require full consensus.

By contrast, conflicting economic interests can be tackled by either making them transparent or by prohibiting references or arguments relating to economic interests in the deliberations in the attempt to reduce power differences (Habermas, 1991; O'Hara, 1996; van den Hove, 2006). If contestation remains, moderation or even arbitration can help to find solutions that are acceptable to the different parties (O'Leary and Bingham, 2004).

Differing claims of legitimacy can be addressed by making the sources and processes of legitimation transparent and by developing and maintaining trust among participants. In particular, accepting different forms of legitimization and representation through democratic elections or through the representation of different bodies of knowledge or experiences seems critical for political as well as non-political stakeholders (Leventon et al., 2016). Therefore, a mutual recognition and definition of these often hidden and thin delineation lines is required.

Finally, conflicts about knowledge claims require transparency among participants about the plurality of knowledge generation processes and their specific strengths and weaknesses. In doing so, trust can be built among participants that results will build on their contributions. However, conflicts also need to be monitored and evaluated throughout the process as conflict lines might shift or aggravate during the transdisciplinary process.

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